The Refrigeration Service Engineer

Vol. 1
No. 7

DECEMBER • 1933

Lubricating Refrigerators—Thermostats and Other Instruments for Service Men—Service Pointers — the Question Box

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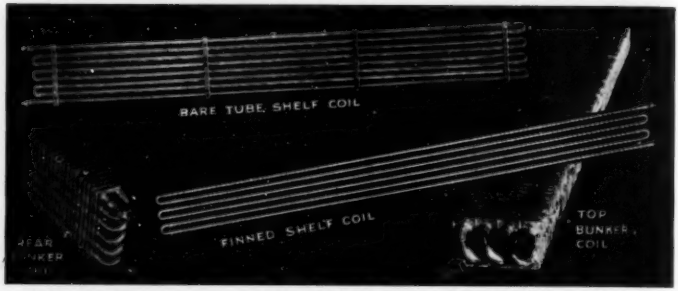

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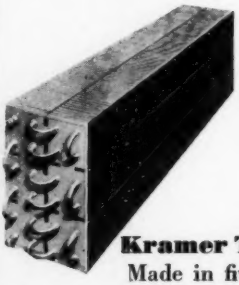

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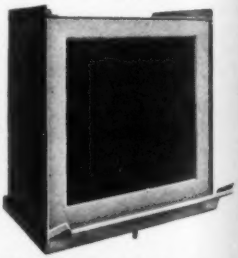

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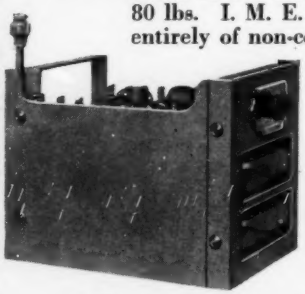

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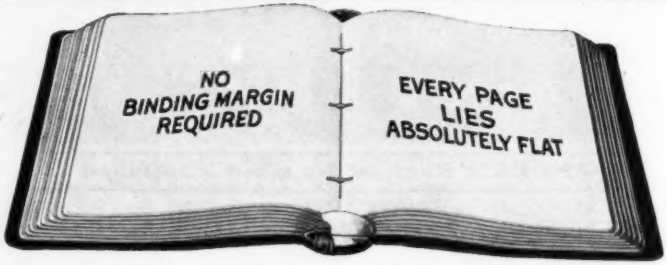

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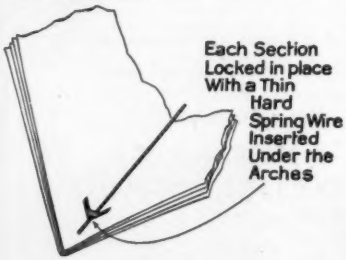

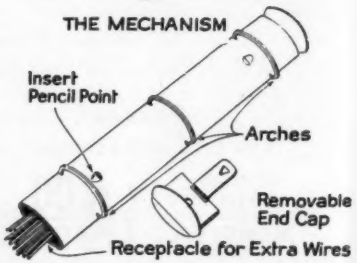

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VOL. 1 DECEMBER, 1933 NO. 7

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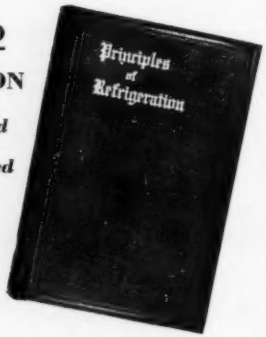

The work is in everyday language, and as free as possible from higher mathematics. The method of treatment has been to present a comprehensive treatise on the fundamental principles. With a firm grounding of these fundamental principles, the practitioner is enabled to intelligently design or operate refrigerating machinery. The theoretical and fundamental operating principles are given attention first. This is followed by numerous practical considerations and the application of the fundamental principles to the economic production of ice and refrigeration for various purposes.

The author has drawn extensively on his wide experience as a refrigeration engineer and teacher of refrigeration engineering, for materials for this work.

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VOL. I. NO. 7 CHICAGO, DECEMBER, 1933 $2.00 per Annum

Lubrication of Refrigerators

Proper Selection of Lubricating Oils for Domestic Refrigerators is Most Important. Action of Various Refrigerants on Lubricating Oils.

By ERICH MEYER, PH.D.*

THE selection of proper oils for lubrication of refrigerators is one of the most important problems of the refrigeration service engineer. It is being realized today, more than ever before, that the use of the proper lubricant will add greatly to increasing the useful life of the refrigerator mechanism and insuring operating efficiency.

There are two distinctly different lubricating jobs in a refrigerator. One is the lubrication of the motor and fan bearings and the other is the lubrication of the compressor.

Lubrication of Motor and Fan Bearings

For lubrication of the motor and fan bearings, the oil is fed commonly by a felt or a piece of wicking thus feeding oil continuously in small quantities to the bearings. The wick reservoir is supplied with oil periodically—once or twice a year is usually sufficient.

It is necessary to use an oil relatively light in body so that the oil is fed properly through the wick. Nevertheless, the body or viscosity of the oil should be heavy enough to provide a film of oil on the bearing surfaces which does not break down under the heat of operation. It is also important that the oil has a low "pour point" because it must flow freely to the bearings when starting up cold.

One of the most important but often overlooked requirements for a lubricant for this purpose, is that the oil should resist deterioration due to oxidation and consequent polymerization. As a result of oxidation and polymerization, the oil may become sticky, clog up the felt or wick and thus interfere with proper feeding of the lubricant. The use of a more highly refined oil, usually classified as a white mineral oil, is usually an insurance against such contingencies. The feature of greater stability of white mineral oils toward oxidation will be discussed later in detail.

Lubrication of Compressors

Most domestic electric refrigerators employ either a compressor of the piston type or of the rotary type. The compressor is self-enclosed and lubricated with oil carried in the base (crankcase) of the compressor.

In the ordinary piston type arrangement, the piston and cylinders are either lubricated by splash or the oil is supplied by pressure to the various points requiring lubrication.

It will be readily appreciated that the selection of a proper oil for the lubrication of compressors presents a very important

* Department of Industrial Research, L. Sonneborn Sons, Inc., New York.

problem to the service engineer when we consider that the refrigerant and the oil are carried together in the same system. This feature makes it imperative not only to control any possible reactions of the metal on the oil or inversely, any reaction of the oil on the metal in the presence of moisture, air and heat but also to check the reaction of the refrigerant on the oil and the reaction of the oil on the refrigerant. It is apparent therefore, that careful attention must be paid by the service engineer to the selection of a proper refrigerator oil.

Two Types of Refrigerator Oil

Refrigerator manufacturers in cooperation with oil companies have devoted a great deal of their research work to the study of this problem. It has been found that the use of highly refined white mineral oils for refrigerator lubrication seem to offer advantages over the use of ordinary so-called "yellow oils" or "pale oils" as refrigerator lubricants.

Causes of Sludge Formation

The most important difference between the above mentioned pale oils and white mineral oils is the fact that all impurities such as "unsaturated hydrocarbons" have been removed from the latter oils in the course of the refining process. The removal of these impurities from oils to be used especially in connection with SO_2 as a refrigerant, has been found advisable since SO_2 has a detrimental effect upon the unsaturated hydrocarbons of the oil. In the presence of moisture, SO_2 forms sulphurous acid. This acid reacts with the unsaturated hydrocarbons of the oil, causing the formation of sludge.

The mere fact that an oil is colorless or "waterwhite" does not in itself signify that the oil is a completely refined mineral oil in the full sense of the word. It is possible to obtain a waterwhite appearance by simple filtration. However, a completely refined white mineral oil in addition to its waterwhite appearance has also been freed of its unsaturated hydrocarbons and this latter characteristic is essential.

Effect of Sludge Formation

Difficulties resulting from oil sludge are encountered in many forms. It is obvious, of course, that sludge accumulation is capable of blocking the oil passages and in this way, interfering with proper lubrication. Sludge can pack behind the piston rings cutting down compression efficiency. It can cause sluggish valve action which likewise reduces efficiency. Sludge carried over to the float valve or to the expansion valve, will cause the valves to stick so that they fail to operate properly. When oil of the proper characteristics but containing an excessive amount of unsaturated hydrocarbons is accidentally carried over into the condenser coils, it will drain out of its own accord but sludge will remain there, seriously impairing the cooling efficiency of the condenser. Any sludge carried past the expansion valve into the expansion coil will, of course, have a detrimental insulating effect there also.

Acid Test as Measure for the Content of Unsaturated Hydrocarbons

The type of oil referred to above as white mineral oil is treated with fuming sulphuric acid in the course of its refining process in order to remove the unsaturated hydrocarbons. The so-called Acid Test[1] serves as an indication of the extent to which the unsaturated hydrocarbons have been removed from an oil. A refrigerator oil from which the unsaturated hydrocarbons have been removed completely should have an acid test considerably lighter in color than pale amber.

Reaction of Air and Moisture

Even under favorable conditions, small amounts of air and moisture get into the refrigerant and this moisture particularly aggravates sludge formation and separation when pale oils are employed. Under severe conditions even a white oil will blacken from attack by the products of SO_2 and moisture, but there will be no sludge separation and the machine will continue to operate efficiently and without trouble.

Various Types of Sludge

The operation of refrigerators in warm climates presents even more complex problems. Instead of an average working temperature of about 180° F, the units will often reach temperature up to 360° F. The cause of the difficulty experienced under such conditions is the formation of an unfavorable type of sludge. We have to distinguish be-

[1] U. S. Pharmacopoeia, 10th Revision (1926), page 282.

tween three different types of sludge: (1) soft and sticky powder, (2) large and hard flakes, (3) hard and dry powder. The formation of the first type of sludge (the sticky powder) is most serious because it tends to clog up the valves permanently since it is not flushed away by the oil. The formation of large particles of flaky sludge is also undesirable, though sometimes a screen filter is provided in order to collect this type of sludge. The least harmful sludge is that which consists of hard and dry powder because it stays suspended in the oil and though it blackens the oil, it will not interfere with the proper operation of the refrigerator.

It has been found that if white mineral oils form sludge under exceptionally severe conditions such as operation in warm climates they always seem to form sludge of the hard and dry powder type, whereas pale oils usually form sludge of the soft and sticky type. Therefore, the cause of difficulties is often not the mere fact that sludge is formed in the refrigerator system but that sludge of the undesirable type is formed.

Sligh Oxidation Test as Measure for Sludge Formation

Recently, attention was devoted to the Sligh Oxidation Test [2] as a criterion as well as a measure for the tendency of a refrigerator oil to produce sludge. The lower the Sligh Oxidation Number, the lower will be the tendency of the oil to sludge. While ordinary pale oils have a Sligh Oxidation Number of about 30 to 40, this figure is reduced to 10 to 20 on semi-refined white mineral oils, whereas completely refined white mineral oils have a Sligh Oxidation Number of below 1.

Carbon Test as Measure for Carbonization

The carbon residue [3] left after complete combustion of the oil can also be properly used as a measure for the tendency of an oil to carbonize under actual operation. Oils of particularly high purity will have a carbon test of as low as 0.005% while the carbon test of a pale oil may sometimes be found to be as high as 0.5%.

Solubility of Oil in Refrigerant and Refrigerant in Oil

In properly lubricating a refrigerator, two additional factors have to be considered, namely, the solubility of the refrigerant in the oil and the solubility of the oil in the refrigerant. Most refrigerants are soluble in oil but particularly in connection with the use of SO_2 it is desirable not to have an excessive solubility of the SO_2 in the oil. Comparative tests at various temperatures were made whereby the solubility of SO_2 in the oil was determined. For example, it was found that at a temperature of 140°F and a pressure of 144 lbs. per square inch, the absorption of SO_2 in a white mineral oil amounts to 16.6%, whereas the SO_2 absorption in pale oils amounted to 29.5% under the same conditions. Since the solubility of SO_2 increases with higher pressure and higher temperatures, it has been generally admitted that this is a very important property of refrigerator oils and one to be closely watched.

As far as absorption of the oil in SO_2 is concerned, it is a well known fact that white mineral oils will not be absorbed by SO_2 since just this feature forms the basis for the so-called Edeleanu Process—one of the modern processes for manufacturing white mineral oils.

Emulsification of Oil

Aside from the solubility of the refrigerant in the oil we have to consider that there may be at times an emulsification of the oil in the liquid refrigerant in the evaporator which, after all, may have the same effect as excessive solubility since it may change the liquid level of the refrigerant in the evaporator. The amount of oil which will emulsify in the liquid refrigerant depends very much on the care which has been exercised in removing all impurities from the oil. There have been many instances where refrigerator manufacturers have run into trouble due to the oil emulsifying to such an extent that the refrigerant was not free flowing thereby preventing proper boiling in the evaporator and thus causing a temperature which disagrees considerably from the corresponding pressure.

[2] A. S. T. M. Proceedings, Vol. 24, Part II (1924), page 964.

[3] A. S. T. M. Method D47-18, Hamor & Padgett, Examination of Petroleum (1920), page 104.

Viscosity Index

The actual emulsification of the oil in the refrigerant depends also to a certain degree on the extent to which the oil increases its body at low temperatures. It is a well known fact that the viscosity of a lubricating oil changes with the temperature. Every oil thins down with an increase in temperature and thickens up with a decrease in temperature. This property can be measured by an arbitrary scale—called Viscosity Index.[4] This scale runs from zero value for oils which do not thin rapidly. The higher its Viscosity Index, the better is the lubricant. Therefore, the Viscosity Index forms an excellent measure for judging the tendency of an oil to maintain its body at high temperatures and to retain its free fluidity at low temperatures.

Pour Point vs. True Fluidity

Free fluidity at low temperature is, of course, of particular importance for a proper refrigerator oil. Very often, the pour point of the oil as determined by the A. S. T. M. method [5] is used as the sole criterion for judging the fluidity of an oil at low temperature. However, in many instances, pale oils, though they may have an A. S. T. M. pour point of about minus 25, become sluggish at that temperature, whereas many white mineral oils stay perfectly fluid even below such temperature. It is undoubtedly essential to select an oil of low "true fluidity" because frequently, difficulties are experienced due to the oil becoming so sluggish at low temperatures that it prevents the free evaporation of the refrigerant from the liquid, thus causing a short cycling of the compressor.

Reaction of Various Refrigerants

The various refrigerants used have different properties in regard to reaction with the lubricating oil. As already discussed in detail above, SO_2 still the most widely used refrigerant today, is decidedly reactive to all but the most highly refined pure white mineral oils.

In connection with the use of Methyl Chloride, Ethyl Chloride, Carrene (Methylene Dichloride), F-12 (Dichlorodifluormethane) particular attention has to be paid to the selection of an oil of very low acidity in order to avoid a troublesome electrolytic phenomenon which is sometimes described as "copper plating." A properly refined white mineral oil of U. S. P. Acid Test should have an acidity of not more than 0.01 mg KOH per one gram of oil which gives the purchaser the assurance that the white mineral oil is completely neutralized after acid treatment.

A further important requirement for oils used in connection with the above mentioned refrigerants is that the oil should contain not more than traces of sulfur and no saponifiable matter at all. Most white mineral oils of proper refining will comply with these specifications.

Use of Glycerine as Lubricant

Formerly, glycerine was used extensively as a lubricant in refrigerators—particularly in connection with CO_2 and Methyl Chloride as refrigerants. Although glycerine has good lubricating properties, it absorbs moisture up to 50% of its own weight, so that it cannot be used unless it is very carefully protected from the atmosphere. Another objection to the use of glycerine is that it sometimes has been a cause of corrosion. Because of these defects, glycerine has been almost entirely replaced by mineral oils for lubricating refrigerating machines.

Moisture

The proper handling of an oil in every stage after it is made is of great importance. In particular, care must be exercised that the oil does not absorb an excessive amount of moisture during handling. Much study has been given to moisture in oil. Refrigerator oil must be thoroughly dehydrated not only because of any potential chemical reactions, but for the reason that any moisture in the oil will freeze out and thus impede the proper flow of the refrigerant. In the electrical test, the moisture content of the oil is determined by subjecting the oil to high voltage and determining the voltage it will resist. It has been generally found that oils with-

[4] Dean and Davis, Chemical & Metallurgical Engineering, Vol. 36 (No. 10), page 618.

[5] A. S. T. M. Method D47-18, Hamor and Padgett, Examination of Petroleum (1920), page 559.

standing a voltage of 25 to 30 KV are satisfactory from the standpoint of moisture content.

Factors Influencing Selection of Viscosity

It is not possible or practical to suggest any one viscosity to meet all conditions. Some refrigerants such as Methyl Chloride, Ethyl Chloride, etc. are more soluble in the oil than others and hence, may cause more dilution and consequent thinning of the oil during use. Therefore, a certain allowance for the anticipated thinning effect has to be provided for by the selection of a somewhat heavier oil.

For small machines, oils with lower viscosities than are required in larger machines may be used; that is, in small machines an oil having a Saybolt viscosity of 150 at 100°F may be satisfactory whereas in larger machines, oils of as high as 300 to 350 Saybolt viscosity at 100°F may be necessary. Clearance, speed of operation, temperature conditions, etc. have also an important bearing on the viscosity of the oil to be used.

Thermostats and Other Instruments of Interest to the Service Engineer

Testing and Recording Instruments Are Important to Every Service Engineer. This Article Describes Various Instruments and Their Function.

By A. F. RUCKS *

AN important part of any refrigerator is the device which through its operation controls the temperature. In most of the modern refrigerators, this device is called a temperature controller. In a comparatively small number of refrigerators manufactured today, a pressure controller is still being used. The pressure instrument was very much in vogue several years ago, but the majority of refrigerator manufacturers have replaced it by the temperature controller, sometimes known as a thermostat.

The temperature controller is nothing more than a thermostatically operated electric switch, which stops and starts the motor when a temperature change in the box takes place. A sensitive bulb is connected to a sylphon bellows by means of copper tubing and this unit is called the tube system. Within it is sealed a volatile liquid under pressure, which vaporizes and condenses as the temperature on the evaporator coil changes. The pressure change within the tube system expands and contracts the sylphon bellows. This motion operates a set of electric contacts that make and break the circuit, thus stopping and starting the motor.

Several years ago temperature controllers, while considerably larger in size than they are today, did not have as many adjustment advantages as the modern controllers. In the older instruments, the housewife did not have the facilities for readily changing the temperature conditions in the refrigerator which are now available in the latest controller models. In order to change to a colder or warmer temperature it was necessary to remove the controller cover and make an intricate adjustment which really required the skill of an experienced mechanic. This, coupled with the inaccessible location of the control unit, made it undesirable to make any adjustments, with the result that only one temperature condition was maintained in the box. Fast freezing for the purpose of making frozen desserts in a hurry or freezing ice cubes quickly was almost impossible with the older controllers.

Today, however, with the improved temperature controller, it is only necessary to

* General Sales Manager, C. J. Tagliabue Mfg. Co., Brooklyn, N. Y.

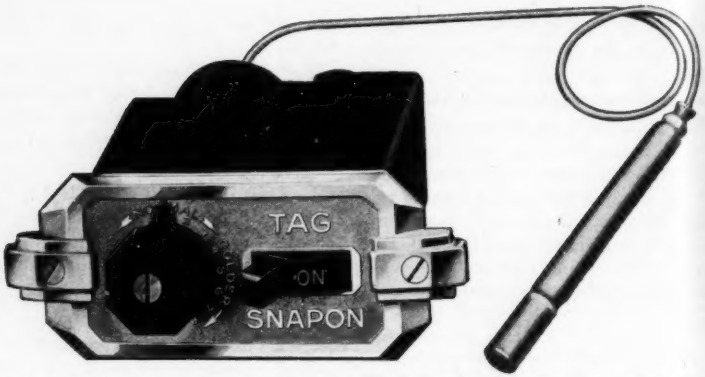


FIG. 1. MODERN TEMPERATURE CONTROLLER FOR DOMESTIC REFRIGERATION

turn a knob, conveniently located on the evaporator shield or on the outside of the refrigerator. See Fig. 1. By means of a dial graduated in reference numbers, varying degrees of fast freezing are easily obtained. The same adjusting knob is used for defrosting, thus eliminating the necessity of disconnecting the wall plug with the resulting danger of allowing the box temperature to rise above safe limits, should the forgetful housewife fail to reconnect the plug. The up-to-date temperature controller is so arranged that when the temperature adjusting knob is turned in the direction indicated on the dial to a defrost temperature, the operating range of the controller is raised, permitting the coils to defrost. During the defrosting period the controller keeps the unit in operation on a higher temperature cycle, and in this manner does not allow the food storage compartment to go beyond the safe temperature.

Temperature Controller

Due to the importance of the temperature controller in the successful operation of a refrigerator, the service engineer should familiarize himself with a few simple rules and tests which will help him to determine whether the controller is the cause of the trouble before he attempts to make any adjustment to the controller mechanism. In a great many cases where controllers are returned to the factory claimed to be defective, an inspection shows there is nothing wrong except that some service man jumped to the conclusion that the trouble was due to the controller.

If a temperature controller has been operating satisfactorily, and then suddenly fails to make circuit when the box temperature rises, the trouble is generally caused by one or two things. First, inspect the wiring for a loose connection. Here again, the latest models of temperature controllers have been improved. The connecting wires are attached to a plug which fits over prongs projecting from the back of the controller case and the service man should make certain that this plug is securely fastened to the prongs. The second place to look for trouble is in the tube system of the controller. Occasionally the tube system develops a leak, due to a break in the tubing or an imperfection in the soldered joint. If the contacts of the controller do not close on a rising temperature, it is safe to assume that a leak in the tube system has occurred and the only remedy is to replace.

Dial Indicating Thermometer

Various instruments are available to guide the service engineer in his work. A miniature size dial-indicating thermometer, Fig. 2, measuring only four inches square indicates the temperature by means of a pointer against a graduated dial. This instrument can be used effectively to check the thermostat setting and to observe the operation of the expansion valve by means of the temperature changes on the evaporator coil. By means of a fine capillary tubing which

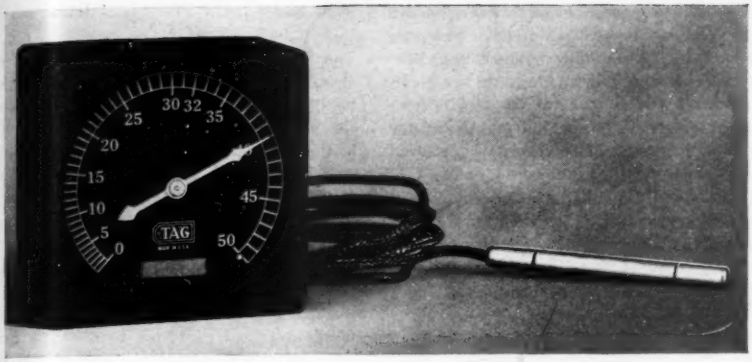


FIG. 2. DIAL-INDICATING THERMOMETER.

connects the instrument proper with the bulb, it is possible to place the dial thermometer on top of the refrigerator with the bulb located inside the box. The tubing is small enough to permit the refrigerator door to close tightly without causing damage. This arrangement enables the service engineer to watch the performance of the unit and check the evaporator coil or food compartment temperatures without opening the refrigerator door.

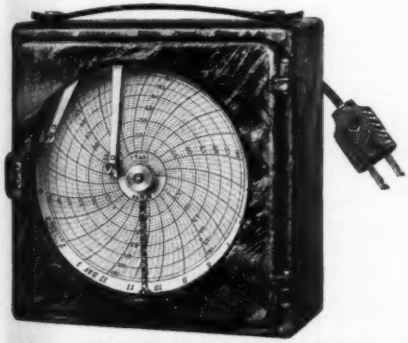


FIG. 3. COMBINATION RECORDING THERMOMETER

Another miniature size instrument known as a recording thermometer, measuring only six inches square, can be used in place of the dial indicating thermometer. This instrument records the temperature on a paper chart instead of indicating it, as is the case with the dial indicating thermometer. The recorder is supplied in two models, one a regular recording thermometer, and the other a combination instrument, shown in Fig. 3. The combination recorder is connected in circuit with the motor, and by means of a second pen, the instrument records running and idling time of the motor, while the other pen writes a record of the evaporator coil or the food compartment temperature.

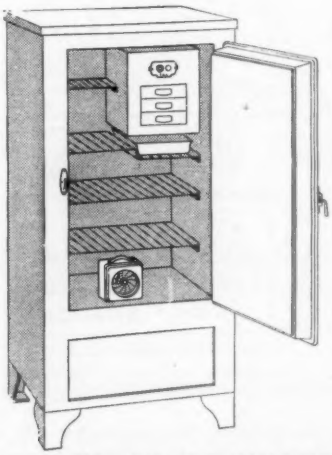


FIG. 4. RECORDING THERMOMETER IN FOOD COMPARTMENT OF REFRIGERATOR.

These recording instruments are made in the self-contained and distance types. The self-contained type is recommended for use when it is desirable to place the entire in-

strument in the food compartment in order to check the temperature of that compartment. See Fig. 4. The distance type permits placing the bulb in the food compartment or on the evaporator coil and allows the instrument to be located outside of the box, so that a complete record is observed without opening the refrigerator door.

Dial-Indicating and Recording Thermometers while more costly than the average glass tube pocket thermometer are easier to read,

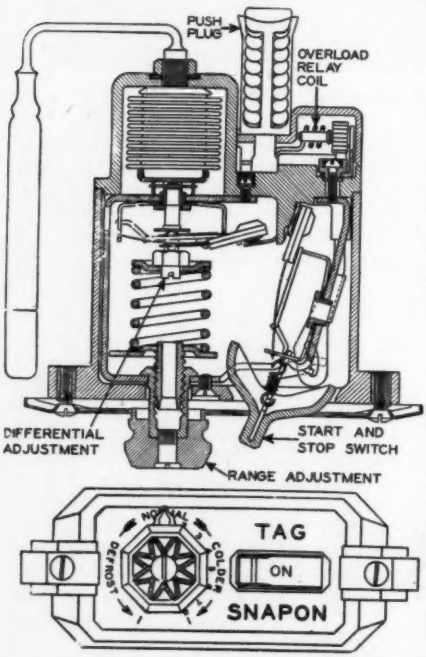


FIG. 5. MODERN DOMESTIC TEMPERATURE CONTROLLER SHOWING OVERLOAD RELAY.

and in addition, the evaporator coil temperatures can be checked more accurately. In a great many cases, complaints about incorrect food compartment temperatures are nothing more than imaginary, and it is very often possible to convince a housewife that her refrigerator is maintaining the correct temperature by showing her a temperature record as actual proof.

Modern science has enabled instrument manufacturers to combine the temperature controller with a protective device usually called the overload relay, shown in Fig. 5. The function of this unit is to break the circuit and stop the motor whenever an overload condition occurs on the motor. When the overload relay trips, the toggle switch is thrown to the "off" position and as this switch is located along side of the temperature adjusting knob, it is readily noticeable that the unit is out of operation. The unit cannot again be expected to give refrigeration until the overload on the motor has been removed, after which it is again possible to reset the overload relay of the controller. If the overload continues to exist, the overload relay will again trip and should this performance be repeated a number of times the housewife should call for a service man.

The toggle switch arrangement just described is only one type. In other controller models, a push pull knob is employed. When the overload relay portion of the controller trips, the push pull knob is thrown out and a red sector on the stem of the knob makes an appearance indicating that the circuit has been broken.

Overload Relay

The overload relay of a temperature controller consists of a heating coil surrounding a stem to which a ratchet is held in place by means of solder. The ratchet is in turn connected to the tripping mechanism. When current is passed through the coil, the stem becomes warm due to heat radiation from the heating coil. Should a condition arise where an overload is placed on the motor, the heating coil becomes hot enough to soften the solder, permitting the ratchet wheel to turn, thus disengaging the lever mechanism and allowing the contacts to break the circuit. The heating coils are tagged with a rating based upon Underwriters requirements as outlined in Underwriters Laboratories Standard for industrial controller equipment.

Due to the large number of different makes of refrigerators on the market, the service engineer is frequently confronted with the problem of obtaining a replacement temperature controller. Often he cannot readily obtain exactly the same controller that he found on the refrigerator. Sometimes the length of connecting tubing may

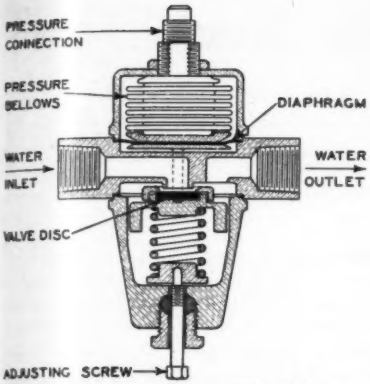


FIG. 6. WATER CIRCULATING VALVE.

vary or the temperature setting is slightly different from that of the controller which he found in the refrigerator. In some cases, where a service engineer finds that the replacement controller is operating at too high or too low a temperature, it can be reset easily by means of an outside adjusting knob, or if desired, the bulb can be shifted to another coil, either closer or further away from the expansion valve. If any excess tubing should result in the installation of a new controller the extra length can be coiled into a spiral behind the evaporator.

So far we have only covered the subject of temperature controls for household refrigerators. There is another field where a great many refrigerating machines are used and that is for commercial installations, such as display cases, ice cream cabinets, butcher boxes, coolers and storage compartments. Some of these installations use pressure controllers while others use temperature controllers. In installations where storage rooms of fairly large area are being cooled, very often temperature controllers are installed with the bulb located within the room itself. If large quantities of materials such as fruits and vegetables are stored, care should be exercised in locating the bulb so that the material is not piled around it, thus interfering with the air circulation in the room. It will be readily seen that if the controller bulb is located in a dead air pocket, the controller is not getting a fair chance to maintain uniform temperature throughout the room. In installations where a blower is used to circulate the air, it is advisable to place the temperature controller bulb near the blower so that the controller

(Continued on page 31)

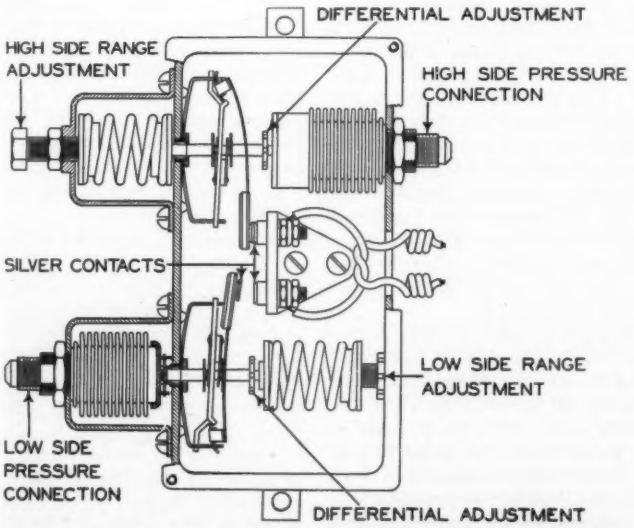


FIG. 7. DOUBLE CONTROLLER FOR COMMERCIAL APPLICATION

The Service Truck

The work of Servicing Domestic and Commercial Units requires immediate and effective results. A service man builds customer good-will on his ability to do a satisfactory job. A mobile shop is desirable.

By E. T. SKINKLE

A LIGHT service truck, fitted up with a bench, a vise, a tool chest, an assortment of copper wire, nails, screws, clamps, boxed valves and fittings, files, pliers, threading tools, drills, reamers, soldering kit, sand paper, emery cloth, paints and paint brushes, an empty refrigerant drum and a full drum of refrigerant; and, if not too costly a combination, small lathe and drill press, will be found indispensable to the service engineer who is determined to "get there" and do a first class job.

Years ago a man was not considered a first class mechanic until he could stand at a vise and, with only a hammer and cold chisel and a file, chip out and finish a hexagon nut and file a thread on a bolt to fit the tapped nut.

Times have changed. Today a mechanic is expected to answer every emergency call at fire alarm speed and come equipped with everything necessary to dismantle the entire apparatus, test and adjust every part, clean and paint where necessary, remove an old charge and all lubricants, put the apparatus together again, connect it up and test it with air pressure, recharge with fresh refrigerant and oil, and stick around long enough to adjust the automatic controls and *know* that the apparatus will perform its functions automatically and positively after he has packed up his kit, started his truck and turned his back on the job.

No need to tell a man how much quicker he can get on the job with an auto-truck than by street car or walking, how much easier to carry his kit on a truck than by hand, or how much quicker a job can be done with the facilities of a properly tool-equipped shop truck at command than when only the limited hand bag is available.

As an example of the convenience and economy of truck service, take the time to stand and watch a trolley line repair truck get on and do a job in a few minutes that would take hours and possibly days to move to and do in a shop. The truck is equipped with everything necessary to tear out and rebuild a section of trolley wire (often with high voltage current on).

The refrigerating service engineer's truck can be similarly equipped with everything necessary to strip and rebuild a refrigerating apparatus right on the premises, without appeal to the sales shop for assistance. Very likely a one-half ton capacity truck would be amply large, if properly equipped, to enable the service engineer to do any emergent repair and adjustment job in the truck, excepting only a complete breakdown or worn-out job. New parts may be required, and perhaps, in future, spare parts will be included in the repair truck equipment.

A light service truck, equipped with a small wire cable winch, lowered a half ton commercial machine from a second story window to the truck, where it was quickly repaired and adjusted and hoisted back through the window, connected up to the evaporator and condenser, recharged and was functioning satisfactorily again inside of three hours' time.

A couple of light, strong calciminers' ladders, with a good footboard spreader, enables temporary access to side walls and ceiling for convenience in hanging coils and making pipe connections, these, when folded up, occupy small space on the running board or side of the service truck and in many instances are a necessity in time economy servicing.

Consider the convenience, actually the necessity, and the time-saving factor of the refrigerator service motor truck. It is a necessity, not a luxury, for the service engineer.

The Control of Refrigerants . . .

[ARTICLE NO. 4 APLLICATION OF VARIOUS VALVES]

Some Practical Pointers on the Installation of Valves. Controlling Refrigeration is a Matter of Proper Valve Installation.

By J. L. SHRODE *

GENERALLY, one valve is used to maintain a constant suction pressure in the entire suction line. All of the evaporators are connected in series. The valve is set for the suction pressure corresponding to the lowest temperature in any one of the units. This results in a lower gas temperature in some of the higher temperature units than would normally be provided. To keep these units from getting too cold they are provided with less coil surface than would be provided if the coils carried the normal gas temperature.

The thermostat is ordinarily installed either in the last unit in the series or in the most important unit, so that when the temperature of that unit is as low as required, the machine will shut down. If the other evaporators are properly designed, the other units will have previously reached their respective temperatures provided there is no great load variation. By the use of by-pass valves across all or part of each unit, the ultimate individual temperatures may be adjusted by the setting of the by-pass valves and by the adjustment of the expansion valve.

The small butcher shop is a typical application of the constant pressure type refrigerating system. Such a system is shown in Figure 1. The expansion valve feeds a counter display case, a brine tank in the butter box, and a meat cooler, all in series. The expansion valve is set to maintain the pressure corresponding to the temperature desired in the cooler coils. The thermostat is located in the meat cooler, which is both the most important unit and the last in the series, and starts and stops the compressor. After the system is in operation it may be that the counter "A" is not cold enough. To lower the counter temperature it is necessary merely to reduce the suction pressure by closing the expansion valve a little. Should the meat cooler "C" not be cold enough, it is necessary only to set the thermostat so that it stops the compressor at a lower temperature, permitting it to run longer.

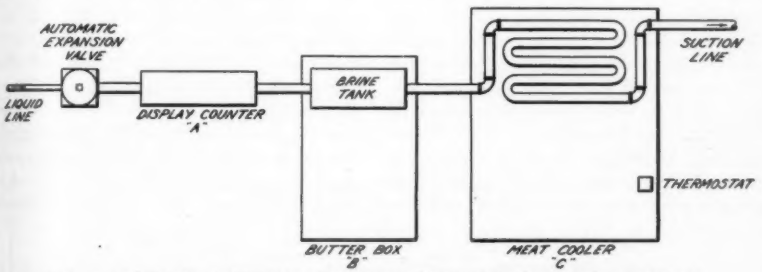


FIG. 1. TYPICAL CONSTANT PRESSURE TYPE REFRIGERATING SYSTEM

Some special applications of the constant pressure expansion valve follow.

Although it has been previously stated that this valve should never be used with a hand expansion valve or other equipment on the same system, there are a few exceptions to this rule. An automatic expansion valve and a hand expansion valve can be used to feed two separate coils in multiple on one machine provided the low side pressure at

*President, Alco Valve Co., St. Louis, Mo.

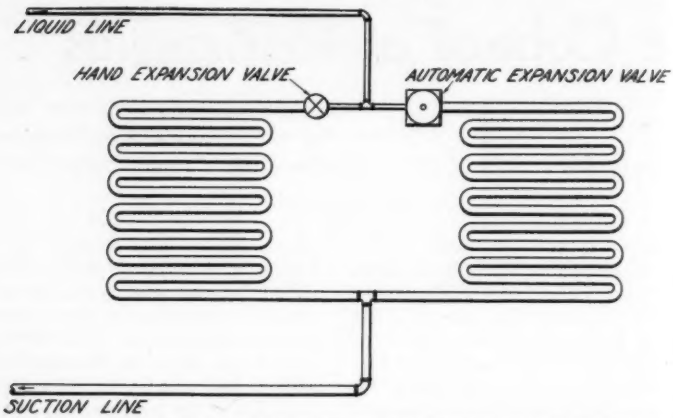


FIG. 2. HAND EXPANSION AND AUTOMATIC EXPANSION VALVE INSTALLATION

the automatic valve is higher than at the hand valve. Such an installation is shown in Figure 2. The system shown will work satisfactorily provided the pressure being maintained in the coils "A" by the automatic valve is higher than the pressure in the coils "B."

One automatic expansion valve of this type can be used to feed two separate coils in multiple, if the size, temperatures, and loads of each coil are equal. Such an installation is not recommended, however, for it is very seldom that two such coils will always have the same temperature and load conditions. See Figure 3 for one such installation. If the load on the coils "A" was greater than the load on the coils "B," the ammonia would flow out of coil "A" and into coil "B" as shown in the sketch. A greater load on coil "A" would cause an increase in suction pressure in "A" and the ammonia would flow into the coils "B," where the pressure would be lower, in an effort to equalize the pressure of the system. The coils of "A" would soon be robbed of ammonia and the operation of the system would not be at all satisfactory.

The use of a pressure regulating valve makes possible the use of a constant pressure expansion valve on a system with other control equipment and varying conditions in its several units. The sketch in Figure 4 shows a freezer on such a refrigerating system being controlled by a constant pressure expansion valve with the aid of a pressure regulating valve. The pressure regulating

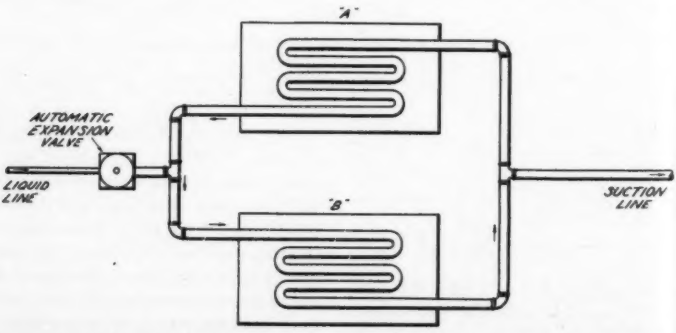


FIG. 3. EXPANSION VALVE INSTALLATION WHERE LOADS ARE UNIFORM

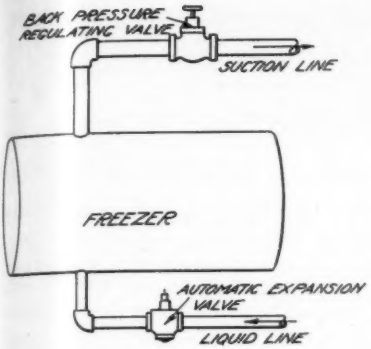


FIG. 4

valve in the suction line maintains a pressure between it and the expansion valve that is higher than the pressure in the main suction line of the whole system. The expansion valve is not affected by variances in suction pressure in other parts of the refrigerating system and, therefore, acts independently on the freezer.

Two constant pressure expansion valves may be used on coils fed in multiple by one machine when a pressure regulating valve is installed in the suction line of one of the units. In Figure 5 two expansion valves are used on one machine; one is set for a 10 pound suction and the other for 25 pounds. There are two separate rooms fed in multiple and these rooms are operated at two different temperatures. The pressure regulating valve in the suction line of the high temperature room maintains a high pressure (25 pounds) in its coils in spite of the lower suction pressure (10 pounds) of the system required to bring the other room down to temperature. Each automatic expansion valve is then able to independently regulate the flow of ammonia into its coils. Such an installation has the disadvantage of not being able to compensate for varying load conditions.

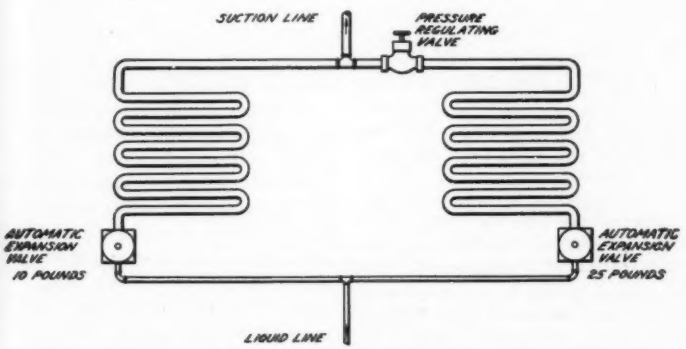


FIG. 5. TWO AUTOMATIC EXPANSION VALVE INSTALLATION

Kelvinator Electric Refrigeration, Michigan.

"Have enjoyed the publication very much, and have also given the subscription cards to nearly all of our accounts, in line with my service contact work in the territory which I make, with the result that nearly all of our distributors' service personnel have sent in subscriptions through their concerns, or individually. Here's hoping you continue increasing the items on short cuts to service problems, and increasing the efficiency of the man directly connected with service troubles in the field."—J. W. Granfors.

Squires' Electrical Refrigeration Service, Florida.

"I find your magazine to be an inspiration in a social as well as a commercial way. Each one of your five issues so far has contained either the names or reproduction of photographs, very familiar to one who has contacted factories, distributors and dealers in the capacity of service engineer. I take the liberty of thanking you for the practical as well as the technical data this magazine contains, which no service man can well ignore."—J. N. Squire.

SERVICE POINTERS

Readers are invited to send descriptions of "kinks" which they have found to be of practical help in their every day work. Just send your idea or sketch in the rough, which will be prepared for publication. All contributors' names will be printed. Address the "Kinks" Editor, REFRIGERATION SERVICE ENGINEER, 433 N. Waller Ave., Chicago.

Motor Grounded

ONE of our regular customers has a Champion multiple system, which is so badly overloaded that he has the low-side switch disconnected in the summer-time to allow the machine to run continuously in order to keep frost on the coils. Two weeks ago I was called to reconnect the switch. Then the fun began.

The motor on this unit is a 1 hp. Century single-phase running 220 V. When I made contact at the switch I blew a fuse, thereby feeding the motor only 110 volts. Imagine my surprise when there wasn't the slightest change in its operation! The motor got off the brushes as well as if it had its full 220 volts and was also up to speed. This made me wonder if the motor leads were hooked properly. I separated them and found they were. Finally I took the one live line lead and touched one lead at a time. The last one I touched ran the motor; one line lead and one motor lead.

What really happened was this. In the interval between the time the switch was disconnected and when I reconnected, the parallel side of the field windings had become grounded. As this is a water-cooled machine, the ground was most likely effected through the water connection. Had there been no convenient route to ground, such as a water connection or bx connections, the motor could not have run.—*Peter Stein Jr.*

Activated Alumina Refrigerant Drier

ACTIVATED alumina is a specially prepared adsorbent for the complete removal of moisture from gases and liquids. It is a partially dehydrated aluminum trihydrate, is chemically inert and a universal drying medium for practically all commercial refrigerants.

The suggested method of application for drying refrigerants is to locate a cartridge containing about one pound of 8 to 14 mesh, Grade A, activated alumina in either the gaseous or liquid circuit. In the majority of cases, the moisture and the refrigerant will be adsorbed simultaneously. However, activated alumina has preferential adsorption for moisture and will hydrate the refrigerant in a closed system to a practically bone-dry condition. This state of dryness will persist until the adsorbent reaches its full capacity for moisture adsorption. The amount of moisture adsorbed at 100% efficiency by the activated alumina will vary between 8 and 15% of its weight, depending on the refrigerant, its rate of flow, the temperature, the mesh size of the activated alumina, etc.

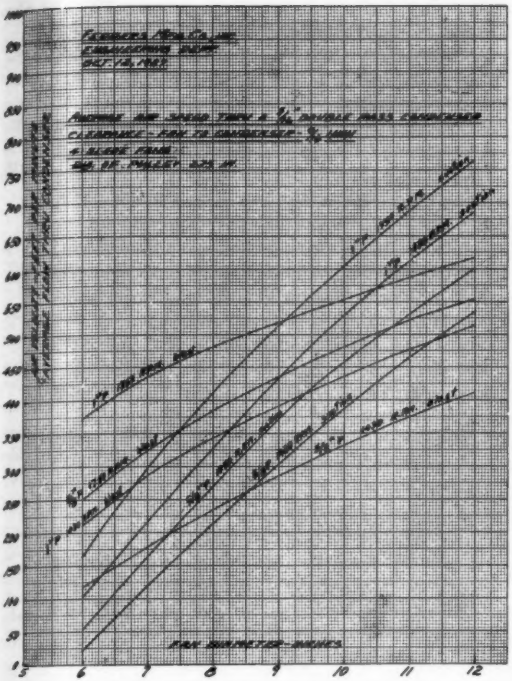
Activated alumina is a granular material, having a very large pore area per unit of volume. It adsorbs water vapor by direct contact from gases, vapors and liquids. As the adsorption phenomena is physical in nature, no chemical action occurs and the adsorbent does not become deliquescent when a state of saturation is reached.

Activated alumina may be reactivated or reconditioned by applying heat to the saturated material at temperatures ranging from 350 to 600° F. After cooling to approximately room temperature it is in condition for renewed adsorption and further use. The cycle of adsorption, reactivation and cooling may be repeated indefinitely without any deterioration or decrease in the adsorptive capacity of the material.

S S S

Norman A. Furey,
Oregon.

"Your magazine is going to fill a need which has been growing rapidly for the last five years."



AIR SPEED THROUGH CONDENSER

PUSH OR PULL CONDENSER

THE following information has been contributed by Mr. J. Askin, Chief Engineer, Refrigeration Division, Fedders Manufacturing Co., in reference to the recommendations on air velocity through condensers appearing in "Service Pointers" in the August and September issues.

Mr. Askin writes: "We wish to contribute the following information as to whether it is better to force air through a condenser, or to suck it."

The tests, the results of which are plotted on the charts illustrated, were run in the laboratories of the Fedders Manufacturing Co. some six years ago, and show that below certain diameters, more air may be obtained by blowing than by sucking, and above certain diameters, a greater amount of air may be obtained by a suction type fan than by a blast type. It will be ob-

FEDDERS MFG. CO., INC. ENGINEERING DEPT.

FAN DATA

Clearance-Fan to Condenser 5/8 inch

Type of Fan	Average Air Speed thru a 5/8 inch Single Pass Condenser—Feet Per Min.				Average Air Speed thru a 5/8 inch Double Pass Condenser—Feet Per Min.				Average Air Speed thru a 5/8 inch Double Pass Condenser—Feet Per Min.				Average Air Speed thru a 5/8 inch Triple Pass Condenser—Feet Per Min.			
	At 1750 R.P.M.		At 1430 R.P.M.		At 1750 R.P.M.		At 1430 R.P.M.		At 1750 R.P.M.		At 1430 R.P.M.		At 1750 R.P.M.		At 1430 R.P.M.	
4 blade	Suction	Blast	Suction	Blast	Suction	Blast	Suction	Blast	Suction	Blast	Suction	Blast	Suction	Blast	Suction	Blast
6 inch dia.—1 inch pitch	173	435	111	296	147	408	94	231	163	375	105	212	122	293	79	166
7 " " " "	316	505	229	331	266	474	194	310	298	435	216	285	223	340	162	265
8 " " " "	437	557	347	398	371	523	294	374	412	480	327	343	309	375	245	268
9 " " " "	544	603	460	452	462	567	390	425	513	520	433	390	385	406	325	305
10 " " " "	641	645	562	505	545	605	477	474	605	555	590	435	453	433	397	340
11 " " " "	727	680	649	553	618	640	558	520	687	587	612	477	516	457	459	372
12 " " " "	810	715	727	597	689	672	617	562	765	617	685	515	574	482	514	402
6 inch dia.—5/8 in pitch	59	290	21	139	50	272	18	131	55	250	20	120	41	195	16	94
7 " " " "	172	377	127	207	146	354	108	194	162	325	120	178	122	254	92	139
8 " " " "	286	447	226	273	243	420	192	256	270	385	213	235	208	301	160	184
9 " " " "	392	505	321	331	333	474	273	310	370	435	303	285	278	340	227	223
10 " " " "	483	560	410	385	411	525	348	362	457	482	387	332	342	376	290	294
11 " " " "	562	606	493	435	477	570	418	408	530	522	465	375	397	363	349	283
12 " " " "	695	645	567	477	540	605	482	450	600	555	535	412	450	433	402	339

served that these tests were run with a four blade fan with a 2¾" diameter pulley attached so that as close to actual operating conditions as possible were maintained.

It will be further noted that the velocity of air signifies the average linear air velocity through the condenser, that is, across the whole face of the condenser.

SNAP ACTION TWO TEMPERATURE CONTROL

TWO-TEMPERATURE control is where two or more temperatures are required in a refrigeration system by maintaining different average suction pressures in the different cooling coils. This type of control is applicable to flooded systems or to thermostatic expansion valve operated dry systems with a pressure control switch on the compressor.

Types of Equipment

To maintain different suction pressures in the different coils, there are two different types of equipment employed: first, throttling valves; and second, quick-acting valves.

Throttling valves can be of two types: first, the automatic; and second, the hand control. The automatic control employs a modulating valve which maintains an opening in the suction line in proportion to the pressure in the cooling coil. Whereas, the hand control employs a hand-operated valve which will maintain a pressure drop in the suction line or between the different cooling coils when the compressor is in operation.

Barostat Snap-Action Valve

The Barostat snap-action valve was developed for temperature control in the cooling coil without sacrifice of compressor capacity or power loss. Therefore, its design provides for a very low loss of pressure through the valve when it is open and there is perfect sealing when it is closed. The adjusting qualities are accurate.

Of course, it was necessary to design Barostat Valves so that ordinary foreign materials in the system would not prevent the valve from sealing. Therefore, when the valve snaps shut there is enough power to remove any small particles of material that may rest between the seat and the stem.

Design and Materials

Stainless steel diaphragms were selected to resist corrosion and rupture of the diaphragm due to fatigue.

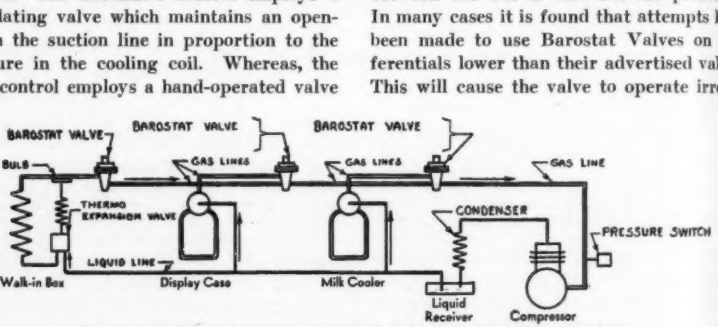
The Valve stem and Valve seat are selected of the highest grade of steel to ensure that foreign particles would not cause a break of seal permanently or temporarily.

Whenever possible, aluminium is used for the shell in order to provide a lightweight unit and corrosive-resistant surface. When methyl or ethyl chloride are used as refrigerants, the bottom casting is made of copper alloy.

Application

The valves available are classified according to their operating ranges. One important consideration should be the differential between the cut-in and cut-out pressures. In many cases it is found that attempts have been made to use Barostat Valves on differentials lower than their advertised values. This will cause the valve to operate irregularly. If any differential is required below seven pounds, a special valve can be provided to take care of it.

In applying snap action valves to a system, their cut-out pressure setting should be higher than that of the compressor switch, to allow for line pressure drop plus a factor of safety so as to ensure proper cycling of the valve. In most cases the valve will have pressure drops less than two

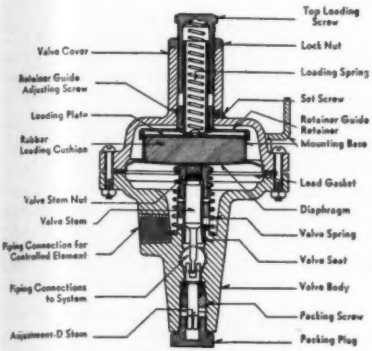


INSTALLATION OF TWO TEMPERATURE CONTROL VALVES

pounds so that the cut-out point of the compressor switch should be at least two pounds below the cut-out point of any Barostat Valve on the line.

Adjustments

Adjustments can be made either in the field or service station. It was found that



CROSS SECTION OF VALVE

the top adjustment will raise or lower equally the cut-in and cut-out pressures a pound for every two and one-half turns of the top screw. The bottom adjustment will go the full range of the differential of the valves in approximately one revolution. Therefore, any changes in the differential should be made by small turns of the bôttom adjustment, that is, one-eighth of a turn at a time.

To adjust the top adjustment for a rise in temperature, turn the top screw downward and vice-versa for lowering the temperature.

To widen the differential of the valve, turn the bottom adjustment to the right and vice-versa to narrow the differential.

RECORDER FOR CHECKING ELECTRIC REFRIGERATORS

A RECORDING device which will stand considerable "kicking around" is offered to service men and the service departments of refrigerator dealers.

It shows running time and quiet time of the motor in electric refrigerators, ice cream cabinets, etc. Running time is the key to the situation in nearly every complaint about electric refrigerators. You know the familiar story: "That box is running all the time."

When the motor is running, a little magnet inside pulls a marker or stylus up against the chart and makes a wide record. When the refrigerator motor is not running, the Recorder stylus draws a fine "idle" line as shown. No ink or pens are used; the record is made by the sapphire stylus scratching off the wax coating on the chart.

The latest model has a two-way switch which makes possible a double-range of 1 to 15 amperes. The receiver can be supplied with either a 24-hour clock and chart, or a 8-day clock and chart.

While it is a tool for the Service Department, it is important to the sales department because it keeps refrigerators sold as will be apparent to any sales manager.

RECORDER FOR DETERMINING ON AND OFF TIME OF REFRIGERATOR

Chicago Refrigeration Code

The Service Man Should Familiarize Himself with the Requirements of His State and City Codes. Herewith is Printed the Salient Features of the Code Adopted by the City of Chicago.

IT is very necessary that the refrigeration service engineer familiarize himself with state and municipal codes, if any, governing the design, construction, installation and inspection of refrigerating systems wherever he may be located. Copy of the complete regulations should be obtained from the proper authority.

As yet there is no standard or uniform code, and no two agree in all particulars. The Codes adopted in New York City and Chicago have probably had a greater influence in shaping codes in other cities than have any other regulations, and these two are not in full agreement; however, some of the essential features are about the same.

Classification of Systems

The enforcement of such regulations are delegated to different city departments. In Chicago, it is the duty of the Chief Inspector of the "Department for the Inspection of Steam Boilers, Unfired Pressure Vessels and Cooling Plants" and his associates to inspect once each year all refrigerating systems where piping, machinery and apparatus is under pressure.

The Code classifies refrigerating systems into four classes according to the number of pounds of refrigerant employed. Only two classes are involved in household and small commercial refrigerating systems: Class C is a system containing more than twenty pounds and not more than one hundred pounds of a refrigerant; Class D is a system containing twenty pounds, or less, of a refrigerant.

The Chicago Code also specifies that no refrigerating system using a flammable or irritant refrigerant or any part thereof shall be placed, located or maintained in

(1) Any room, dinette or kitchenette used for sleeping purposes.

(2) Any room having an adjoining alcove, adjoining room or suite of rooms, any part of which is used for sleeping purposes, the combined cubical contents of which is less than four thousand (4,000) cubic feet unless such room or rooms above set forth are provided with a window or windows, the total window area of such being not less than ten per cent of the floor area of such rooms and unless such window or windows shall open to the outside air and be so constructed that at least one-half of such window or windows can be readily opened.

Direct expansion coils or coolers of systems using non-flammable or non-irritant refrigerant may be installed in the air ducts of air cooling and air conditioning systems on any floor of any building provided:

(1) Coils or coolers are constructed of non-corroding materials or permanent protection against corrosion in same is provided.

(2) The coils or coolers are tested to a pressure of at least one and one-half times the minimum test pressure specified for the refrigerant.

(3) Provided that the total refrigerant content of systems containing more than 500 lbs. of refrigerant shall not exceed 1 pound for each 150 cubic feet of volume in the space to which the air is conducted.

All poisonous or toxic refrigerants used in any direct system of refrigeration shall have a distinct and easily detectable odor or characteristic irritating properties.

No reconstruction of old apparatus or installation of new shall be undertaken unless plans and specifications for same shall be filed in the office of the Department and approved by the Chief Inspector. Such plans and specifications shall show the kind and amount of refrigerant used. It is provided, however, that only the general plans and specifications for each type or model of a single unit system which can be removed

from its premises either with the refrigerated cabinet or separately without disconnecting the refrigerant containing parts, shall be submitted to the Chief Inspector. A general permit shall be issued by the Inspector authorizing the placing or installation of such approved types or models. No annual inspection shall be required on a unit system used for household purposes installed by authority of said general permit, provided that the Chief Inspector may make inspection of any said unit system whenever in his judgment inspection is necessary for the protection of life and property.

The permit for Class C household multiple and remote systems was fixed at $5.00 for each pressure imposing element and 25c for each evaporator. The permit fee for Class D household multiple and remote systems is $3.00 for each pressure imposing element and 25c for each evaporator.

Class "C" and "D" Requirements

For refrigerating systems of Class C or D, when other requirements are not fulfilled, shall use seamless copper tubing or other suitable metal of not less than thirty-four one-thousandths of an inch wall thickness. Provided, further, that the joints are sweated or brazed or properly annealed and flared or of other construction approved by the Chief Inspector.

In all Class C systems and in all Class D multiple refrigerating systems where seamless metal tubing of less than standard pipe thickness for refrigerant line or lines is used, the refrigerant line or lines shall be enclosed in iron pipe or tubing or other metal enclosures. The enclosures may be of flexible metal at bends or terminals if not exceeding six feet in length and if enclosure is rigidly secured to the wall or other supports. No metal enclosure shall be required for refrigerant lines between the pressure-imposing element, condenser, or shell type apparatus and the nearest riser box, provided these lines do not exceed six feet in length and are located within the refrigerating machinery room where such room is required.

All valves and fittings in such system except those with the evaporator, pressure-imposing element, liquid receiver or shell type apparatus and every connection of tubing shall be arranged in or on a suitable metal box and shall be rigidly attached thereto or to the supports thereof. Every such box shall have an accessible door or removable cover.

Location of Shut-off Valves

Shut-off valves for systems extending into living quarters shall be installed at the following locations: At each service outlet in pressure and return lines, and in each riser or manifold connection at or near the compressor. These valves shall be fitted with a hand wheel or other means of ready operation as an integral part thereof.

Evaporators of low-side float type which may be removed as a unit shall have valves permitting the removal of the evaporator with valves attached.

Not more than one refrigerator shall be connected to any outlet box. Every such outlet box shall be located within the premises containing the refrigerator, but not within the refrigerated space, and shall be readily accessible at all times. No outlet box shall be located in any hallway, stairway or vertical shaft.

Service valves shall be installed in both connections to every household flooded type evaporator that can be removed from the refrigerator as a unit, in such a manner as to permit the removal of the evaporator with valves attached. This is not required on unit systems.

No refrigerant line shall be located in any elevator, dumb-waiter or any other shaft containing moving objects.

Safety Requirements

Every evaporator used in a household refrigerator, unless constructed of sufficient strength to prevent injury in the ordinary and customary use thereof, shall be protected by suitable shield to assure protection against such injury. Every such evaporator shall be firmly anchored or secured in such manner as to make it immovable.

Every refrigerator cabinet, box, casing or refrigerated space containing or enclosing any evaporator of any multiple refrigerating system using the direct method of refrigeration shall be firmly and securely anchored and fixed to a wall, floor or other immovable object in such manner as to hold such re-

frigerator, box or casing enclosing the evaporator securely in place.

Check valves in an absorption system shall be located between rectifier and condenser and in the discharge line as close as practicable to the aqua pump.

Every compressor or pressure-imposing unit of the water cooled type except unit machines, shall be provided with a by-pass, in such manner as to permit transference of refrigerant from one part of the system to the other.

Every compressor or pressure-imposing element must be equipped with gauges on the high and low pressure side, except automatic types using less than 50 lbs. total weight of refrigerant.

Every part of every refrigerating system, except pressure gauges and control mechanism, shall be designed, constructed and assembled to withstand safely, and without injury, the following required minimum test pressures which shall be applied for the pressure test. These test pressures shall be held by every refrigerating system under test for a period of at least eight hours without an appreciable fall.

TEST PRESSURE IN POUNDS PER SQUARE INCH

Refrigerant Used	High Pressure Side	Low Pressure Side
Carbon dioxide	1,500	750
Ethane	1,100	550
Ammonia	300	125
Propane	250	125
Methyl chloride	175	125
Sulphur dioxide	135	100
Isobutane	135	100
Butane	100	50
Ethyl chloride	100	50
Dichloromethane	15	15
Trichloroethylene ...	15	15
Dichloroethylene	15	15

The manufacturer of every unit refrigerating system shall mark upon the name or model plate thereof the kind of refrigerant contained within the system. Every Class C and Multiple Class D system shall have the name of the refrigerant painted or affixed in a permanent manner either to the pressure imposing element or to the piping in proximity thereto. The kind of a refrigerant and instructions for shutting off refrigerant shall be prominently posted at the branch valves used for shutting off each evaporator or set of evaporators contained within each refrigerated space.

When dichlorodifluoromethane is used in connection with commercial and industrial ventilating systems, the Chicago Board of Health has adopted the following regulations:

The use of dichlorodifluoromethane as a refrigerant shall not be considered entirely free from hazard to health.

Any container, pipe or part of a refrigerating system in which dichlorodifluoromethane is used and located in a ventilating system in the air to be used for ventilating purposes, shall be designed, constructed and assembled to withstand the test pressure of four hundred (400) pounds per square inch without injury to any part of such container, pipe or part of the refrigerating system.

Any joint or connection in the refrigerant containing part of a refrigerating system in which dichlorodifluoromethane is used and such joint is located in a ventilating system, shall be threaded, welded, brazed, sweated or of such type of construction as is approved by the Board of Health.

Any joint or connection in the refrigerant containing part of a refrigerating system in which dichlorodifluoromethane is used and which may be opened, moved or altered after the test pressure has been applied, shall not be located in a ventilating system.

In every refrigerating system in which dichlorodifluoromethane is used, and a part of such system containing the refrigerant is placed into a ventilating system in the air to be used for ventilating purposes, there shall be provided such means as will produce a signal sufficient to attract the attention of the person or persons responsible for the operation of such equipment in case at any time ten pounds of the refrigerant should escape from the refrigerating system.

S S S

R. Carr, Michigan.

"Enclosed find check for payment of subscription to THE REFRIGERATION SERVICE ENGINEER. I received your November issue and read it through and it is of real value to us fellows."

Ordinance Regulates Service Business

Los Angeles Adopts Ordinance Requiring License and Posting of Bond. New Law Designed to Protect Concerns Doing Servicing Work.

LOS ANGELES has adopted a city ordinance, which requires that all persons engaged in installing and servicing of electric refrigeration equipment will require a certificate of registration, a payment of a $25.00 fee, and the posting of a $1000.00 bond. This matter has been under consideration for approximately a year, and is the result of conferences by service organizations, manufacturers, distributors and dealers, in conjunction with the Los Angeles Department of Building and Safety.

The original Los Angeles Refrigeration Ordinance required, as in other cities, that a permit be taken out for refrigeration equipment installed, removed or placed. In some Pacific Coast cities, it was required that an inspector examine the equipment after the completion of each service call, which, of course, made this impractical because of the large number of permits issued; therefore, the bond provision was included which is intended to protect the customer in case an installation did not meet the Los Angeles Refrigeration Ordinance, or the term of the new ordinance licensing the installers. The ordinance is as follows:

Ordinance No. 73,174

An ordinance providing for registration of persons, firms, or corporations engaged in the business of installing, altering, repairing, or servicing refrigeration systems and providing penalty for violation of same.

The People of the City of Los Angeles do ordain as follows:

Sec. 1. Certificate of Registration Required. It shall be unlawful for any person, firm, or corporation to engage in or carry on or to represent or to advertise himself, herself, itself, or themselves as engaged in or carrying on the business of installing, altering, repairing, adding to, or servicing any refrigerating system as defined in Sec. 230 of Ordinance No. 28,700 N. S., until such person, firm, or corporation shall have first registered at the office of the Superintendent of Building of the Department of Building and Safety of the City of Los Angeles, and obtained a Certificate of Registration as a Refrigeration Contractor as hereinafter provided in this ordinance.

For the purpose of this ordinance, the term "Refrigeration Contractor" shall mean any person, firm, or corporation installing, altering, repairing, adding to, or servicing any refrigerating system as defined in Sec. 230 of Ordinance No. 28,700 N. S., provided, however, that the term "Refrigeration Contractor" shall not include any person who personally does such work in a building owned by and also occupied by such person, nor to any person doing such work under the direct supervision and in the employ of a "Refrigeration Contractor."

Sec. 2. Application for Certificate of Registration. Every person, firm, or corporation desiring to be registered and to obtain a Certificate of Registration as a Refrigeration Contractor shall make application in writing to the Superintendent of Building of the Department of Building and Safety of the City of Los Angeles on blanks furnished for that purpose. Every such application shall give the name and address of such person, firm, or corporation, and, if a firm, shall give the names of the members thereof, and, if a corporation, shall give the names of at least three (3) of the principal officers thereof. Every such application shall give such additional information as the Board of Building and Safety Commissioners may consider necessary to carry out the intents and purposes of this ordinance, and such application shall be verified upon oath by such person, or, if a firm, by a member thereof, or, if a corporation, by an officer thereof, as the case may be, or by the duly authorized agent of such person, firm, or corporation.

Every such application shall be accompanied by a bond executed to the City of Los Angeles by a surety company authorized so to do, or by a corporation having the authority to act in such capacity.

In form, said bond must be joint and several and in the sum of One Thousand Dollars

($1,000.00), and said bond must be conditioned that the whole or any part of said One Thousand Dollars ($1,000.00) shall be paid to any person who has suffered damage by reason of the violation of any provision of this ordinance, or by reason of the violation of any of the provisions of Ordinance No. 28,700 N. S., or of any ordinance amendatory thereof or supplementary thereto.

Said bond shall not be void upon the first recovery, but may be sued and recovered upon from time to time by any person who has suffered damages as herein referred to, in his own name until the whole penalty is exhausted.

The sufficiency of the surety company shall be approved by the Department of Building and Safety, and every such bond shall be approved as to form by the City Attorney of the City of Los Angeles.

That the surety company executing such bond shall agree to make any installation or construction work done by said principal comply with the provisions of Ordinance No. 28,700 N. S. and with the provisions of any ordinances amendatory thereof or supplementary thereto, in the event that said bonded principal shall fail, neglect, or refuse to make any such installation or construction work comply with said ordinances.

Every Certificate of Registration shall expire on June 30th of the fiscal year in which the same is issued.

Sec. 3. Fee For Certificate. Before the issuance of any Certificate of Registration to a Refrigeration Contractor, as provided in this ordinance, the applicant therefor shall pay to the Board of Building and Safety Commissioners a fee of Twenty-five Dollars ($25.00) for the use and benefit of the City of Los Angeles.

Sec. 4. Revocation of Certificate of Registration. The Board of Building and Safety Commissioners may, upon its own motion or upon the complaint of any person, revoke any Certificate of Registration of any Refrigeration Contractor for any of the following reasons:

1. Violation of any of the provisions of Ordinance No. 28,700 N. S. relative to the installation, alteration, repair, or adding to any refrigerating system.

2. Violation of any of the provisions of this ordinance.

3. Fraud or misrepresentation in connection with any refrigerating system.

Before revoking any such Certificate of Registration, the Board of Building and Safety Commissioners shall hold a public hearing at which any such Refrigeration Contractor may present evidence and reasons in defense of his Certificate of Registration, either in person or by his attorney; and before any such hearing is held, any such Refrigeration Contractor shall be given written notice at least ten (10) days prior to said hearing.

Whenever any such Certificate of Registration has been revoked, it shall be unlawful for any such Refrigeration Contractor to install, alter, repair, add to, or service any refrigerating system until such person, firm, or corporation has obtained a new Certificate of Registration and paid the fee required therefor by this ordinance.

The revocation of any Certificate of Registration shall not be deemed or construed to exempt any Refrigeration Contractor from any other penalty provided for in this ordinance or any other ordinance of the City of Los Angeles.

Sec. 5. Penalty. Any person, firm, or corporation violating any provision of this ordinance shall be deemed guilty of a misdemeanor, and upon conviction thereof, shall be punishable by a fine of not more than Five Hundred Dollars ($500.00), or by imprisonment in the city jail for not more than six (6) months, or by both such fine and imprisonment.

Every such person, firm, or corporation shall be deemed guilty of a separate offense for each and every day during any portion of which any violation of this ordinance is committed, continued, or permitted by such person, firm, or corporation and shall be punishable therefor as hereinbefore provided in this section.

Sec. 6. The City Clerk shall certify to the passage of this ordinance by a unanimous vote and cause the same to be published once in the Los Angeles Daily Journal.

I hereby certify that the foregoing ordinance was passed by the Council of the City of Los Angeles by the unanimous vote of all members of said Council present, there being not less than twelve (12) members present, at its meeting of October 17, 1933.

Robt. Dominguez,
City Clerk.

Approved this 26th day of October, 1933.

Frank L. Shaw,
Mayor.

* * *

P. E. Chatham,
Washington, D. C.

"This is the best magazine for service men that I have yet seen and I wish you every success."

Arthur F. Burmeister,
Michigan.

"It is the greatest magazine I ever found, and is worth many times the price."

THE Question BOX

Readers are invited to send their problems pertaining to the servicing of household refrigerators and small commercial refrigerating equipment as well as oil burners to "The Question Box" which will be answered by competent authorities.

THE following questions were presented at Chicago Chapter of the Refrigeration Service Engineers Society and answered by C. E. Hamilton, chairman of the Educational Committee.

Question 21. Will beer pull the taste of Prestone or any anti-freeze through the walls of block-tin tubing?

ANSWER. No. Block-tin tubing is too dense. Since the beer is under pressure and the anti-freeze is not, if there were leakage, it would be a leakage of beer into the Prestone. However, the use of a sweet water bath for the beer coils is to be recommended instead of an anti-freeze solution. If too low a temperature is maintained, there is danger of freezing the beer in the coils.

Question 22. Where can you purchase parts for the Belding-Hall refrigerator?

ANSWER. Write Roth Brothers, 2073 Greenleaf Ave., Chicago, Ill. This concern, I understand, has a stock of parts for this machine.

Question 23. Where can you purchase parts for the Articair refrigerator?

ANSWER. Contact Kulair Corp., Philadelphia, Pa., and The Starr Co., Richmond, Ind.

Question 24. What kind of compressor is used in a Belding Hall refrigerator?

ANSWER. Rotary gear compressor is employed (trade name ElectrIce) having a charge of 9.35 lbs. of sulphur dioxide.

Question 25. I have been working on a Crosley refrigerator. I have purged for air and recharged, but the suction pressure goes to twenty inches of vacuum and the suction line frosts. Why should this line frost and gauge go to twenty inches of vacuum on low side?

ANSWER. The Crosley machine employs a capillary tube for the refrigerant flow control. Symptoms would indicate that an excess of oil is circulating through the systems and this oil is causing oil binding of the capillary tube and, also, that this oil is carrying a certain amount of liquid refrigerant over into the suction line where it evaporates, resulting in a frosted suction line.

Question 26. What is meant by "flash gas?"

ANSWER. The refrigerant entering the cooling unit is warm, close to room temperature. About ten per cent of the refrigerant, depending upon the condenser temperature, evaporates instantly, upon passing through the refrigerant flow control, thereby cooling the balance of the refrigerant to the temperature in the cooling unit. This refrigerant that first evaporates is called "flash gas."

Question 27. What effect does the flash gas have on the efficiency of the system?

ANSWER. The efficiency is reduced as full benefit of the latent heat of the liquid is not derived. For example, the latent heat per pound of sulphur dioxide at 5° F. is 169 Btu. See table given below.

COMPARATIVE REFRIGERATION IN BTU PER CUBIC FOOT OF CYLINDER DISPLACEMENT

REFRIGERANT	Refrigeration Per Cu. Ft. Displace	Latent Heat at 5° F.	Refrigerating Effect Per Lb. of Refrigerant
Dichlorodifluoromethane	2.7	162.1	134.9
Ether	3.61	170.8	126.3
Ethyl Chloride..	8.35	177.0	142.3
Butane	12.3	169.5	123.5
Isobutane	17.4	159.5	111.5
Sulphur Dioxide..	22.0	169.38	141.37
Methyl Chloride..	31.1	178.5	140.42
Freon	34.4	69.47	51.07
Propane	51.7	169.5	121.0
Ammonia	58.3	565.0	474.45
Carbon Dioxide...	212.0	115.3	56.69

The REFRIGERATION SERVICE ENGINEER

A Monthly Illustrated Journal, Devoted to the Interests of the Engineer Servicing Refrigeration Units, Oil Burners and other Household Equipment.

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REFRIGERATION SERVICE ENGINEERS' SOCIETY

The Publishers of the
REFRIGERATION SERVICE ENGINEER
extend the
Season's Greetings
and
Sincere Wishes
For the Fulfillment of All Your
1934 Anticipations

REPEAL INCREASING REFRIGERATION DEMAND

IT is a significant fact that advancement in many industries and businesses has developed new uses and increased demand for refrigeration. One of the promising markets for additional refrigeration will undoubtedly be brought about with the repeal of the prohibition law. The past summer has shown a large increase in the use of refrigeration for beer cooling. The dispensing of beer at the proper temperature has received greater attention than at any previous period. The storage of barrel beer at proper pre-cooling temperatures has naturally resulted in more demands for refrigeration.

With total repeal now a fact, other refrigerating devices and additional refrigerating requirements are making the possibilities for service of greater importance than ever before. For example, additional capacity for the making of ice-cubes will undoubtedly offer possibilities, and service companies maintaining refrigerating equipment in restaurants, hotels, stores and other establishments dispensing beverages, are in a position to recommend additional refrigerating equipment, thereby increasing their revenue.

LICENSING REGULATION

IN this issue is published in full the ordinance recently adopted by the Los Angeles, California, City Council, regulating companies and individuals engaged in installing and servicing electric refrigeration equipment, which became effective on December 2.

This ordinance provides for certificate of registration with a payment of a $25.00 fee and the posting of a $1,000.00 bond. The purpose of establishing a licensing fee of $25.00, it is stated, is that the licensing department will be self-sustaining.

The $1,000.00 bond provision was adopted in order that the customer would be protected in cases where an installation not in conformity with the Los Angeles refrigeration ordinance, or in accordance with the new licensing ordinance just adopted, would be changed.

No provision as yet has been made for the examination of applicants for certificates, as to their experience and knowledge of refrigeration work. Of course, this is important if the ordinance is to be a success.

The responsible service organization will no doubt welcome any movement in the direction which tends to regulate the itinerant service man, and gives assurance to the customer that the concern or individual doing the work is thoroughly responsible.

With the rapidly increasing sale of mechanical refrigerators, and the consequently increasing field for service men, it is to be expected that this business has and will attract men, who fail to recognize their responsibility to the consumer.

This ordinance may not be the panacea for all servicing ills that are experienced in different localities, but it represents an effort to discourage unethical practices.

COMPLAINT CHART NO. 7

C=CAPILLARY TUBE
LF=LOW SIDE FLOAT
HF=HIGH SIDE FLOAT
DA=AUTOMATIC EXPANSION VALVE
DT=THERMOSTATIC EXPANSION VALVE
T=THERMOSTAT CONTROL
P=PRESSURE CONTROL

CAUSES OF COMPLAINT	SYSTEMS						
	LF		HF		C	DA	DT
	T	P	T	P	T	T	P
COMPLAINT NO. 14—BAD SMELL IN CABINET AND BAD TASTING FOOD.							
(a) Refrigerant leak	√	√	√	√	√	√	√
(b) Dirty refrigerator	√	√	√	√	√	√	√
(c) Poor refrigeration	√	√	√	√	√	√	√
(d) Congealing tank alcohol spilled	√	√	√	√	√	√	√
(e) Old accumulated frost	√	√	√	√	√	√	√
COMPLAINT NO. 15—SWEATING ON OUTSIDE OF REFRIGERATOR							
(a) Poor fitting doors	√	√	√	√	√	√	√
(b) Very damp weather	√	√	√	√	√	√	√
(c) Poor insulation with excess refrigeration	√	√	√	√	√	√	√
(d) Poorly ventilated and damp room	√	√	√	√	√	√	√
COMPLAINT NO. 15A—ICE CUBES FREEZE BUT REFRIGERATOR TOO WARM							
(a) Air circulation blocked in cooler	√	√	√	√	√	√	√
(b) Poor fitting doors	√	√	√	√	√	√	√
(c) Too much frost on evaporator	√	√	√	√	√	√	√
(d) Poor insulation	√	√	√	√	√	√	√
(e) High service factor (hot foods)	√	√	√	√	√	√	√
(f) Food packed too close, paper on shelves	√	√	√	√	√	√	√

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Cut out along outer line and insert in binder for ready reference.

FOR LEATHER BINDER WRITE TO H. T. McDERMOTT, SECRETARY REFRIGERATION SERVICE ENGINEERS' SOCIETY
433 N. WALLER AVE., CHICAGO, ILL.

REFRIGERATION SERVICE ENGINEERS' SOCIETY

Official Announcements of the activities of the National Society and Local Chapters appear in this department as well as articles pertaining to the educational work of the Society.

THE OBJECTS OF THE SOCIETY

To further the education and elevation of its members in the art and science of refrigeration engineering; with special reference to servicing and installation of domestic and small commercial equipment; for the reading and discussion of appropriate papers and lectures; the preparation and distribution among the membership of useful and practical information concerning the design, construction, operation and servicing of refrigerating machinery.

ASSOCIATION HEADQUARTERS: 433-435 North Waller Ave., CHICAGO, ILL.

MEETINGS OF CHAPTERS

Detroit Chapter No. 1

Meeting of October 18

PRESIDENT GEORGE H. CLARK presided at the meeting held at the Danish Brotherhood Temple, 1775 W. Forest Ave. Mr. Downs reported on the work of the Educational Committee, and advised that speakers had been selected for future meetings, and that members were also requested to make suggestions on the subjects in which they were most interested. Mr. Clark reported the result of a conference with Mr. Mills, City Inspector, in reference to the licensing and bonding of installation and service men. Motion was made and seconded that Mr. Clark secure further data and report at the next meeting.

Meeting of November 1

After disposing of the usual order of business, the meeting was turned over to the Educational Department, and Mr. Nelson, of the Riley Engineering Co., gave an interesting talk on "The Application of the High-Side Float Valve."

As there were a number of new men in attendance, President Clark explained the purposes and objects of the Society.

Following this, there was a general discussion on the bonding and licensing of contractors and service men, and it was reported that this matter had been taken up with Commissioner Wolf and Mr. Mills, the City Inspector.

Mr. Downs, of the Educational Committee, then gave an interesting talk on "The Cost of Service Calls."

Greater Chicago Chapter No. 1

Meeting of November 14

AFTER dispensing with the usual order of business, President T. J. Fowler turned the meeting over to Mr. C. E. Hamilton, chairman of the Educational Committee, who introduced as the speaker of the evening, Mr. Carl Buddenbaum, whose address on "The Development and Future of Refrigeration" emphasized the rapid strides made by mechanical refrigeration and what future possibilities will develop.

There was discussion, also, regarding plans for a special evening of entertainment, at which time the charter for Chicago Chapter is to be presented.

Meeting of November 28

After dispensing with the business session of the meeting, Mr. V. Allen, of the Automotive Maintenance Machinery Co., gave a most interesting talk and demonstration on "The Development of Several Tools for the Repairing of Compressors." In Mr. Allen's demonstration, he showed by actual work the purpose of the tools.

At this meeting, six new applications were received.

Chicago Chapter regrets the loss of one of its ardent supporters and valued members, in the sudden death of Mr. S. C. Fischer, who was widely known among the service men or Chicago, having conducted, for some years, a shop specializing in the rebuilding and repairing of motors used in household refrigerators. Mr. Fischer had attended a regular meeting of the chapter on November 14, and was suddenly stricken the following Thursday. The services were held on Saturday, November 18.

New York Chapter No. 1
Meeting of November 10

STARTING the fall and winter meetings of New York Chapter, the first of which was held on November 10, the meeting was called to order by President Herbert Herkimer.

Considerable time was devoted to the discussion of a standard form of agreement for electric refrigeration servicing and installations, which with modifications and changes is substantially the same as the form which appeared on page 11 of the August issue of this journal.

It was also decided that the members, for the next thirty days, should canvass prospective contractors on the new form, and report the sales resistance met with at the next meeting, and any changes recommended should be considered at that time.

As part of the educational program, an interesting talk was given on "Oil Burners," by Mr. G. Sealon, instructor at the Herkimer Institute of Mechanical Trades, Oil Burner Division.

New Jersey Chapter No. 1
Meeting of November 22

PRESIDENT JOHN C. HUMMELT, after disposing of the routine business, called upon Mr. Edward Lampa, secretary, who spoke on the future plans for Northern New Jersey Chapter, and the necessity of each member doing his part to further the interest of the chapter and the Society in general.

Action was also taken, in view of the many inexperienced men in the jurisdiction of Northern New Jersey Chapter, who are terming themselves contractors, that this chapter endeavor to ascertain some method of regulating the business, and the secretary was delegated to draft tentative regulations to submit to the chapter for further discussion.

THERMOSTATS
(Continued from Page 13)

will regulate the temperature of air being circulated throughout the room.

The service engineer should endeavor to familiarize himself with the construction of pressure and temperature controllers used on commercial refrigerating machines. These instruments in general are very simple in their construction and the adjustments, while not as readily accessible as controllers used on household refrigerators, are easy to make. The indicating gages which every service man uses, should enable him to make the necessary adjustments to get proper temperature control in the display case or other refrigerated application.

On water cooled units a water circulating valve, shown in Fig. 6, is furnished which regulates the flow of the condensing water. On units of this type, a double controller is usually used. This instrument, see Fig. 7, has a high pressure cut-out attachment that breaks the circuit in the event that the condensing pressure continues to rise beyond the capacity of the water circulating valve.

As in the case of household refrigerators, such instruments as dial-indicating and recording thermometers can be used to great advantage by the service engineer in his work.

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